1.14 USE OF REMOTELY SENSED AND IN SITU DATA TO INVESTIGATE THE EFFECTS OF SURFACE HETEROGENEITY AND TERRAIN ON THE SPATIAL AND TEMPORAL DISTRIBUTION OF SENSIBLE AND LATENT HEAT FLUXES IN THE SEMI-ARID SAN PEDRO BASIN

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1. INTRODUCTION

Remote sensing observations of the surface, obtained from aircraft or satellite-borac instruments at visible (VIS) and infrared (IR) wavelengths, have been proposed as the basis for providing regional estimates of heat and moisture transfer from the ground to the overlying atmosphere. There are a number of complicating factors in the way of obtaining accurate estimates of sensible (H) and latent (LE) heat fluxes by remote sensing techniques not the least of which is the mismatch in temporal and spatial scales between remote sensing and ground based measurements. Most can-cat remote sensing algorithms combine measurements of a radiative sensor (e.g., IR radiometer) with ancillary ground based measurements (e.g , anemometer mounted at a height of 2-3 m above the ground). Then, not only do the characteristics of the instruments come into play - the field of view of the IR radiometer and its viewing angle versus the anemometer whose measurement is made at a single point downwind from a source area, or footprint - but also the process of combining remote sensing and in situ measurements is called into question

Remote sensing measurements are spatially extensive and temporally limited while in situ measurements are just the opposite. There are vet-y few studies that address the fundamental problems of combining near instantaneous remote sensing imagery with ground observations collected at a limited number of locations and averaged over intervals on the order of one-half to oat-third of an boa-. In this study, we attempt to use the resources of the Semi-Aricl Land Surface Atmosphere (SALSA) experiment of August 1997 to investigate some of these problems.

2. DATA COLLECTION

The experimental details of the SALSA 1997 experiment are given in other papers in this special edition '1 he data wc used in our analysis was a combination of aircraft and ground based observations taken on the morning of August 15 from about 1000 to 1200 LT.

During this time, the sky conditions were mostly clear with some cumulus clouds forming over nearby mountain ridges during the latter part of the data collection period The 1x)]:. Cessna Citation flew six flight lines, along and across the San Pedro River Basin, over Walnut Gulch, parallel to the US-Mexico border, and near the Elgin Research Ranch either at low (6.6 Kft) or high (19.8 Kft) altitudes which yielded ground pixels of 5 or 15-m sire. Two instruments were mounted in the aircraft: the Thermal Infrared Multispectral Scanner ('TIMS) which has six channels in the thermal IR from 8.2 to 12.2 µm, and has an IFOV of 2.5 mrad, and the Thematic Mapper Simulator ('TMS) which has seven channels from ().42 to 0.90 µm and five other channels from 0.91 to 2.35 nun and 8.5 to 12.5 µm

At several locations on the ground at Lewis Springs and Walnut Gulch, there were a number of flux and meteorological measuring instruments including Bowen ratio systems, sonic anemometers, fine wire fast response thermocouples, and UV fast response hygrometers. Data collected on the ground were sampled at 5-10 Hz and averaged over 30 minute intervals.

3. ANALYSIS OF H AND LE OVER SELECTED AREAS OF THE SAN PEDRO RIVER BASIN

We calculated H and LE from resistance formulations with particular attention to the effects that terrain (elevation and slope), vegetative cover, surface variation in emissivity and kinetic temperature have on the difference in radiometric (T_{rad}) and air (T_{air}) temperature. Results were compared with eddy correlation measurements made at specific locations. The calculation of T_{rad} - T_{air} is made difficult by the fact that T_{rad} is a near instantaneous measurement while T_{air} is a halt' hour average "1 hc source areas of T_{rad} and T_{air} fire made consistent through Taylors "frozen flux" theorem

We used the digital cartographic database from the EROS Data Center to characterize the terrain, a temperature emissivity separation (TES) algorithm to produce separate data bases of spatial variations of surface emissivity arid kinetic temperature from the TIMS data, and various algorithms to calculate vegetation indices [rem the TMS data

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